BNL-95007-2011-AB

BOUNDARY LAYER (BL) THERMAL EDDIES OVER A PINE FOREST FROM CARES 2010

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For presentation at
The Second Science Team Meeting of the
Atmospheric System Research (ASR) Program,
San Antonio, TX
March 28-April 1, 2011

Environmental Sciences Department/Atmospheric Sciences Division
Brookhaven National Laboratory

U.S. Department of Energy
Office of Science

ABSTRACT

The Gulfstream G-1 research aircraft (AAF) participated in the CARES 2010 field campaign in June 2010. Included in the onboard research equipment was the BNL accelerometer and the BNL high-sensitivity gustprobe. These two instruments provide two independents means of measuring the vertical velocity of the boundary layer sampled by the G-1 along its flight path. The sampling rate of both of these instruments was 200 Hz, which with G-1 aircraft speed of 100 m/s, provided a spatial resolution of 0.5 meters. After signal processing to remove the motion of the G-1, the vertical velocity data was averaged to 10 Hz, which corresponds to a spatial resolution of 10 meters. The resolution of the vertical velocity as measured by the gustprobe was about 0.1 cm/sec; the accelerometer resolution was about 0.25 cm/sec, slightly noisier. The agreement between the vertical velocities as measured by these two techniques (accelerometer and gustprobe) was excellent. An aerial UHSAS (Ultra High Sensitivity Aerosol Spectrometer) was also included in the G-1 research package, which was a ARRA purchase. The UHSAS measured the boundary-layer aerosol particle concentration from 55 to 1000 nm diameter, sized into 100 bins. The attached figure, a plot of the vertical velocity, is in m/s on the left axis, and shows the sum of all aerosol particles per cc, as measured by the UHSAS versus time. This is a 30-second segment of the June 28, 2010 morning flight, from 18:13 to 18:13:30 UTC. This corresponds to a 3-km segment flown in the boundary layer over a pine forest east of Sacramento, California, the most easterly leg of the sampling flight plan. Note the high degree of correlation between the vertical velocity and the total number of aerosol particles. The three sets of downdraft/updrafts beginning at about 18:13:18 UTC are three thermal eddies, about 250 meters wide, in the boundary layer. These thermal eddies are formed from the solar heating of the surface and help to form the boundary layer. The eddy updrafts are transporting aerosols from the pine forest below, and the eddy downdrafts are transporting air from above the boundary layer, diluting the aerosol particle concentration. These measurements will be used to calculate the aerosol particle fluxes from the pine forest into the boundary layer.